Menlo Park Notebook #188 [N-81-01-25]

This is one of six notebooks that were probably begun on January 10, 1881. It contains notes on gas lighting and electricity by Charles L. Clarke, which appear to be related to Edison's proposed book on electric light and power. (See Menlo Park Notebook #184.) There are also notes on generators and conductors and eight loose pages that relate to "proportioning the cost of conductors." The label on the front cover is marked "C. L. Clarke." This book contains 284 numbered pages.

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Notes on Gas-Lighting.

Consumption,

Rates of –

See Modern Street Lighting by Sugg.

Curves of –

Rate per lamp per hour,

Rate per lamp per quarter,

Hours of burning per quarter,

statistics upon street lighting at Nottingham and Folkestone.

Plot curves for book.

"Not Wanted. Data are only upon street lamps."

Wanted – Curves of daily consumption as to time and amount.

Ridicule.

Bessemer process.

Jeans' Steel.

Page 54 & 2.
" 65

Entire chapter compact with facts of this nature.

Krupp's steam hammer

Jeans' Steel.

page 190.

Refusal of Patent
on the most-general
grounds.
Siemens regenerative
furnace.
Jones Sheet.
Page. 104.

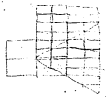
Obstruction of Light-
by globes of different-
materials and clear
glass. Table of -
Gas Engineer's Almanac
by American Meter Co.
1880.

Mixing with air.
Effect of -
Table of per cents of
mixture and loss of light.
Gas Engineer's Almanac
Tur tables, American Meter Co.
1880.

Illuminating Power
Loss of.

By deposit of hydro-
carbons in the mains
in cold weather.

Statement Gas Engineers Almanac
only, without American Meter Co.
table. 1880.



1 3. 5. 7
1 7. 9 11.

Standard Gas Burner.

16 candles - 24 holes.
3 inch flame
7 x 1 3/4 proper chimney
5 cu. ft. per hour =
16 sperm candles, 65 1 lb.

Residual Products.

Birmingham Gaslight and Coke Co. in 1874 up to June out of a total receipt of 80,000 l. obtained 7000 l. from residuals and needed but 9000 l. to declare a 6 % dividend. Thus 7/9 of the sum was obtained for this half yearly dividend.

Vol. 18 p. 305. Engineering. Oct. 16. 1874

Total London Companies in 1873
Total received for gas
2 504 402 l.
For products, ammoniacal liquor, tar, coke, and breeze
950 000 l.

Gas per Ton of Coal.

London Companies in first half of 1874 consumed 2365581 tons of coal, producing 2300386000 ft. of gas or 9723 ft. per ton. 8634 were actually consumed, the remainder being lost in leakage or consumed on premises. Ordinary Coal used.

Engineering, Vol. 18, p. 305. Oct. 16. 1874.

Total Coal in London Companies in 1873 - 1430931 tons costing 1753715 £. Gas sold 12,248,643,300 cu. ft.

Engineering, Vol. 18, p. 72

Leakage

See page 20.

Capital
Invested.

London
10032-9552. of which
8 3/4 millions are paid in.
in 1874. Engineering Vol. 18. July 24, 1874

Deterioration of Coal.

Coal deteriorates by exposure to air and moisture and causes serious loss. and companies cannot hold large lots.

437 1/2

7 | 17 [illegible]

Philadelphia

Report of Trustees of Gas Works. 1880.

No. of Lights	No. of meters	Total Lights.
3	50801	152403
5	26584	132920
10	13157	131570
20	4112	82240
30	927	27810
45	474	21330
60	228	13680
100	328	32800
150	42	6300

Lights	Sq. root of total lights	Sq. root of meters	Per cent of total
3	390	225	25 %
5	364	163	22
10	362	115	21.9
20	287	64	13
30	167	30	4.7
45	146	22	3.6
60	117	15	2.5
100	181	18	5.6
150	79	6.5	1.7

Field of Force.

Speak of the importance of running close to face of field as possible and give calculations on the actual effect of such a change. Make comparison of the relative commercial advantages of getting requisite E.M.F. with high or low internal resistance. For example, as a particular case, is it more economical to make the machine 15 to 1 to get the requisite E.M.F. or give more room so as to get 30 to 1 and obtain the same E.M.F. by strengthening the field by enlarging the magnets and copper?

Draw curves showing for a desired E. M. F. where commercially is the limit of energy which can be permitted to excite the field when compared with the weight of iron and copper, which can be increased in order to decrease the energy expended in exciting the field.

The reason why permanent magnets are not used, the investment invested far exceed the cost to excite and electro magnet, when their cost is capitalized.

Magnet Tests.

Select three magnets which have recently been rewound and have fiber washers on the ends of the core, and accurately measure their resistance

Start in the afternoon by throwing out the field and then strengthen the field gradually, taking the deflection for every few degrees so as to get points sufficiently close to accurately determine the curve. Take the deflection from terminals of magnet + machine, and measure the resistance of armatures. After the field has been thus run up, bring it down

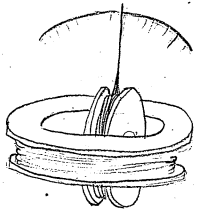
gradually taking the readings of the galvanometer as before. Take all the readings to right and left.

2nd Set of Exp.

If dynamo is not giving over 100 volts put in the external circuit a resistance beginning with 1.5 ohms, as near as convenient, take the deflection around the terminals of dynamo, Vary the resistance increasing it to about 13.5 ohms and note the deflections, keeping the field constant. Do this for the three machines.

3rd Set of Exp.

Electric Dynamometer.



Fig

Impossibilities.

W. H. Preece in Engineering Vol. 27, page 81 — Jan. 24, 1879

After a long mathematical investigation he concludes as follows:—

"It is this partial success in multiplying the light that has led so many sanguine experimenters to anticipate the ultimate possibility of its extensive subdivision — a possibility which this demonstration shows to be hopeless, and which experiment has proved to be fallacious."

E. M. F. curves -
John Hopkinson -
Engineering - Vol XXVII.
page 403

By same writer
Vol XXIX
page 424

Jan 25th 1881.

Conductors.

The weight and therefore cost of conductors for the same number of lamps varies as the area over which they are distributed.

For example :- If conductors for a central station system of 10000 lights distributed over a certain area cost — $60000, the cost for the same number of lights distributed over twice the area will be $120000, for three times the area $180000 and so on.

7/400
57

14
57
1
77

Proof.

Weight of Copper $\propto$ distance^2.

Area $\propto$ distance^2.

$\therefore$ Weight or Cost $\propto$ Area.

If lamps are evenly distributed, that is, the same number of lamps for a unit of area the weight and therefore cost of conductors will vary as the area or number of lamps.

Proof Lamps $\propto$ area

but area $\propto$ distance^2

$\therefore$ Lamps $\propto$ distance^2

but Weight of Copper per Lamp $\propto$ distance^2

$\therefore$ Weight or Cost $\propto$ Lamps or Area.

Wanted.

A diagram showing the advantage of sub-division over one central light of great power, to be shown by diagram of circles.

Curve of field magnet

3 sizes

Also iron and copper investment.

at 10% interest, Energy line.

[ITEM FOUND IN BOOK]

Proportioning
the
Cost of Conductors
so that the
Interest and Depreciation
on the
Cost of Conductors
and
Power-Producing Plant
and,
Loss of Power
shall be a
Minimum.

No. of Lamps + size of district constant

x = Capital Invested in Conductors.

m = % interest on same.

n = % depreciation.

a = cost of producing the energy developed in the Lamps.

y = loss in conductors.

z = ratio of resistance in conductors to resistance in Lamps.

Proportioning the cost of conductors so that the interest and depreciation on the cost of conductors and power-producing plant and loss of power shall be a minimum.

Number of lamps and size of district constant

x = Capital in Conductors — variable

m = % interest — constant

n = % depreciation — constant

~~AK = Cost of one of the lamps used.~~

A = the amount of energy consumed, meaning fuel, oil +c.

z = ratio of resistance in conductors to the resistance in lamps. — variable

AKz = Cost of energy lost in conductors.

Az = the amount of energy lost "

K = Cost of fuel +c per unit of energy — variable

[ITEM FOUND IN BOOK]

$$T = (m+n)x + wA(1+g)(t+u) + C(g+r) + S + s + AK(1+g)$$

differentiate and place = 0

$$(m+n)dx + (t+u)wAdg + ds + AdK + Ag\,dK + AKdg$$

but $g \propto \frac{1}{x}$

$$g = \frac{c}{x}$$

$$dg = -\frac{c}{x^2}dx$$

~~Cost of unit of energy $\propto K$~~

~~$w \propto A(1+g)$~~

$wA(1+g)$ = capital invested in power

and $AK(1+g)$ = cost of that power

Let the ratio of capital to cost be R

then $\frac{w}{K} = R$ a constant

The ultimate unit of energy in Europe

Total expense

$$T = (m+n)x + (1+g)a + w(t+u) + C(g+r) + S + s \quad (1)$$

in which x, g, a, w, s, are variables, differentiating and placing equal to zero

$$(m+n)dx + da + adg + gda + (t+u)dw + ds = 0 \quad (2)$$

$$a \propto K$$

$$\therefore \quad a = AK, \quad (3)$$

$$da = AdK$$

also (4)

$$g \propto \frac{1}{x}$$

$$g = \frac{c'}{x} \quad (5)$$

$$dg = -\frac{c'}{x^2}dx \quad (6)$$

$$w \propto A(1+g)$$

$$\therefore \quad w = c''A(1+g) \quad (7)$$

$$dw = c''Adg \quad (8)$$

$$S \propto A(1+g)$$

a = capital invested which would not be altered by change in the amount of power produced, as real estate, pipes for conduction, meters, &c

q = % interest.

r = % depreciation.

w = Capital invested per unit of energy which is altered in proportion to the change in the amount of power produced, as engines, dynamos &c

t = % interest

u = % depreciation.

S = Executive salaries and like expenses which do not change with amount of power.

s = wages at stations and like expenses which change with amount of power.

[ITEM FOUND IN BOOK]

Assume that the cost of plant per dollar of power is z and at p% interest and q% depreciation.

Then for the general case:—

$$y = za, \qquad (1)$$

$$z \propto \frac{1}{x}$$

$$z = \frac{c}{x} \qquad (2)$$

$$c = zx \qquad (3)$$

True cost of interest, depreciation and power

$$C = mx + nb(a+y) + a + y \qquad (4)$$

differentiating we have, placing it at zero

$$m\,dx + nb\,dy + dy = 0 \qquad (5)$$

from 1 and 2

$$y = \frac{ac}{x} \qquad (6)$$

from which

$$dy = -\frac{ac}{x^2}\,dx \qquad (7)$$

substitute this in eqn. 4

$$m\,dx - \frac{abcn}{x^2}\,dx - \frac{ac\,dx}{x^2} = 0$$

[ITEM FOUND IN BOOK]

$$\therefore\ mx^2 - abcx - ac = 0$$

$$x = \left[\frac{ac}{m}(2m+1)\right]^{\frac{1}{2}}. \qquad (8)$$

by equ. 5

$$y = \frac{ac}{x}$$

substituting

$$y = \frac{ac}{\left[\frac{ac}{m}(2m+1)\right]^{\frac{1}{2}}}.$$

$$\therefore\ y = \left[\frac{ac}{m(2m+1)}\right]^{\frac{1}{2}}. \qquad (9)$$

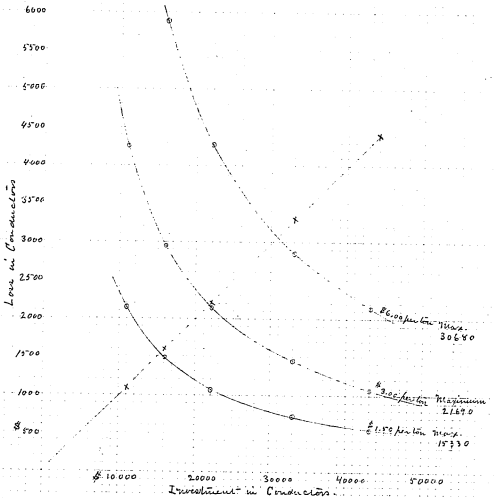
by equ. 2

$$z = \frac{c}{x}$$

substituting

$$z = \frac{c}{\left[\frac{ac}{m}(2m+1)\right]^{\frac{1}{2}}}.$$

$$z = \left[\frac{mc}{a(2m+1)}\right]^{\frac{1}{2}} \qquad (10)$$



[ITEM FOUND IN BOOK]